

Grid Reliability and Renewable Energy

Science, Technology and Telecommunications
Committee

Presented by Dr. Dennis Morrison
New Mexico Tech

November 9, 2012

Grid Reliability and Renewable Energy (Funding)

DOE	\$3,278,000
NM Programs used as Cost Share	
NM Hydrogen Initiative	\$ 344,811
Internal NMT funds	\$ 191,043
Overhead credit	\$ 24,400
Private Sector Participation	
EMCORE	\$ 257,401
Total	\$4,095,655

Grid Reliability and Renewable Energy (Research Elements, 1)

- **Microgrid Reliability, Instrumentation and Testing
(Emphasis of this Presentation)**
- **Microgrid Reliability Modeling**
- **Challenges in Developing Renewable Distributed Energy
Resources**
- **Biomass to Hydrogen Reforming Nanoclay based
Membranes and Electrodes for Fuel Cells Plasma Surface
Modification of Pt-Carbon Supports Novel Thick Film**
- **Microstructures for Dye Sensitized Photovoltaic Cells**

Grid Reliability and Renewable Energy (Research Elements, 2)

- **N-Aryl Arenecarboximides as Panchromatic Dyes for DSSC Applications**
- **Biomass/BioFuel Production using Algae**
- **Update - New Mexico Center for Energy Policy (NMCEP), Hobbs, New Mexico**
- **Design and Development of a Supercritical Biodiesel Reactor System**

Grid Reliability and Renewable Energy



Energetic Materials Research and Testing Center

A Research and Training Division of New Mexico Tech in Socorro, NM

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Energetic Materials Research and Testing Center (EMRTC)

Explosives Research and Testing

The Energetic Materials Research and Testing Center (EMRTC), a major research and training division of New Mexico Tech, is internationally recognized and has over 60 years experience in explosives research and testing. EMRTC specializes in the research, development, testing, and analysis of energetic materials for both corporate and government clients.

As one of several research divisions of New Mexico Tech, EMRTC has access to university faculty with experience in a wide variety of scientific and technical disciplines. EMRTC's 40-square-mile field laboratory is located in the mountains adjacent to the New Mexico Tech campus in Socorro, New Mexico. The field laboratory contains more than 30 test sites, gun ranges, other research facilities and storage areas, allowing for a complete spectrum of research and testing activities. EMRTC has the ability to conduct tests involving over 20,000 pounds of explosives.

<http://www.emrtc.nmt.edu/>



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IERA is a dynamic and growing institute focused on client requirements and deliverables. IERA has a full-time professional research staff across a broad range of disciplines, drawing upon the expertise of other research centers and academic units within the university. IERA has access to a broad base of faculty competencies and students and frequently teams with industrial partners.

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<http://www.iera.nmt.edu/>

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Advancing the Science of Security™



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Military Training

PTRC creates an authentic hyper-immersive training environment specifically designed to allow the training audience a maximum number of opportunities to achieve its training objectives. Potential missions include: Integration of joint tactical enablers supporting distributed operation, joint distributed lethal and non-lethal combat operations, airborne insertions (free fall, static line and heavy drop), marksman live fire and high angle live firing, MOUT in an eastern (Iraq, Afghanistan, and Horn of Africa) environment. [READ MORE](#)

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Energy Research at Playas NM



Institute for Engineering Research and Applications,
Albuquerque, NM

Project Goals

- Utilize the unique facilities at Playas, NM for the **retrofit** of distributed energy assets to **allow testing and evaluation** of advanced energy sources for **security and reliability** benefits.
- Further Instrument the Playas grid to characterize the installed distributed energy resources in terms of their capacity to reliably serve the separate **critical loads** and support the performance of the grid at large
- **Evaluate Next Generation** Solar PV Modules and Inverter Technology
- Design 2 intelligent home energy systems using next generation component, including inverter, energy storage Apply only the **newest technologies** and compare results.
- **Implement SCADA and Web based control** of PV solar power systems
- **Sub Meter 3 commercial buildings** using Web based 2 way communications
- More **secure** local energy supplies for critical infrastructure
- Increased **power quality** and/interface reduced outage costs to consumers

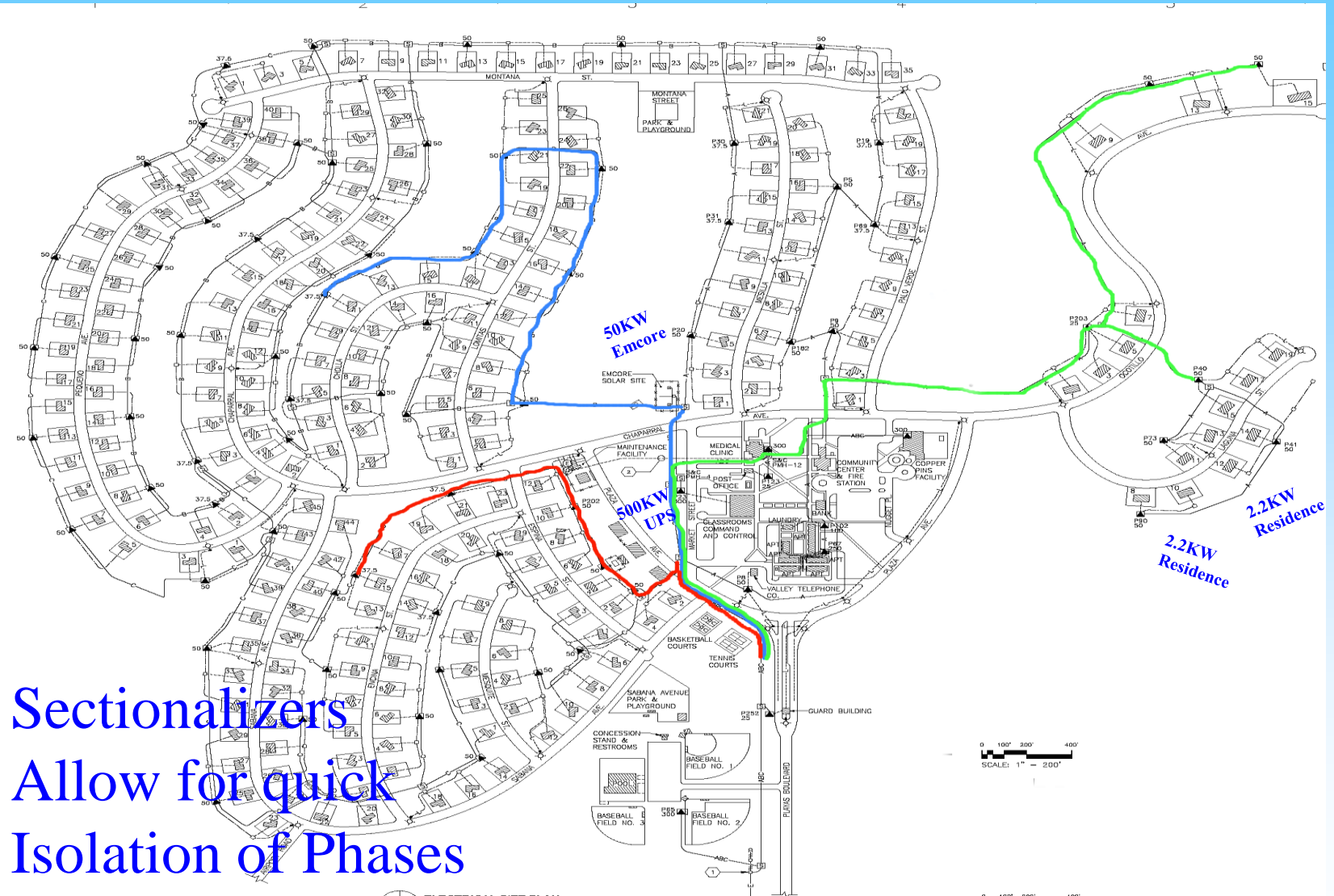
About Playas Training and Research Center (PTRC)

- The Town site is owned by NMT and is 640 Acres
- Additional 1200 Acres Surround the Town
- 259 Single Family Homes (1300 ft² – 3800 ft²)
- 25 Apartment Units
- Community Center, Day care and RV park
- Fire Station
- Fully Equipped Medical Clinic with Ambulance
- Airstrip (~5000 ft)
- Wide Streets with Street Lights
- Three Water Wells
- Elevated Water Storage Tank (200,000 gallons)
- Wastewater Treatment Plant
- Giga-bit Fiber Optic network installed at every building

Playas Aerial View



Electrical Diagram of Playas



Sectionalizers
Allow for quick
Isolation of Phases

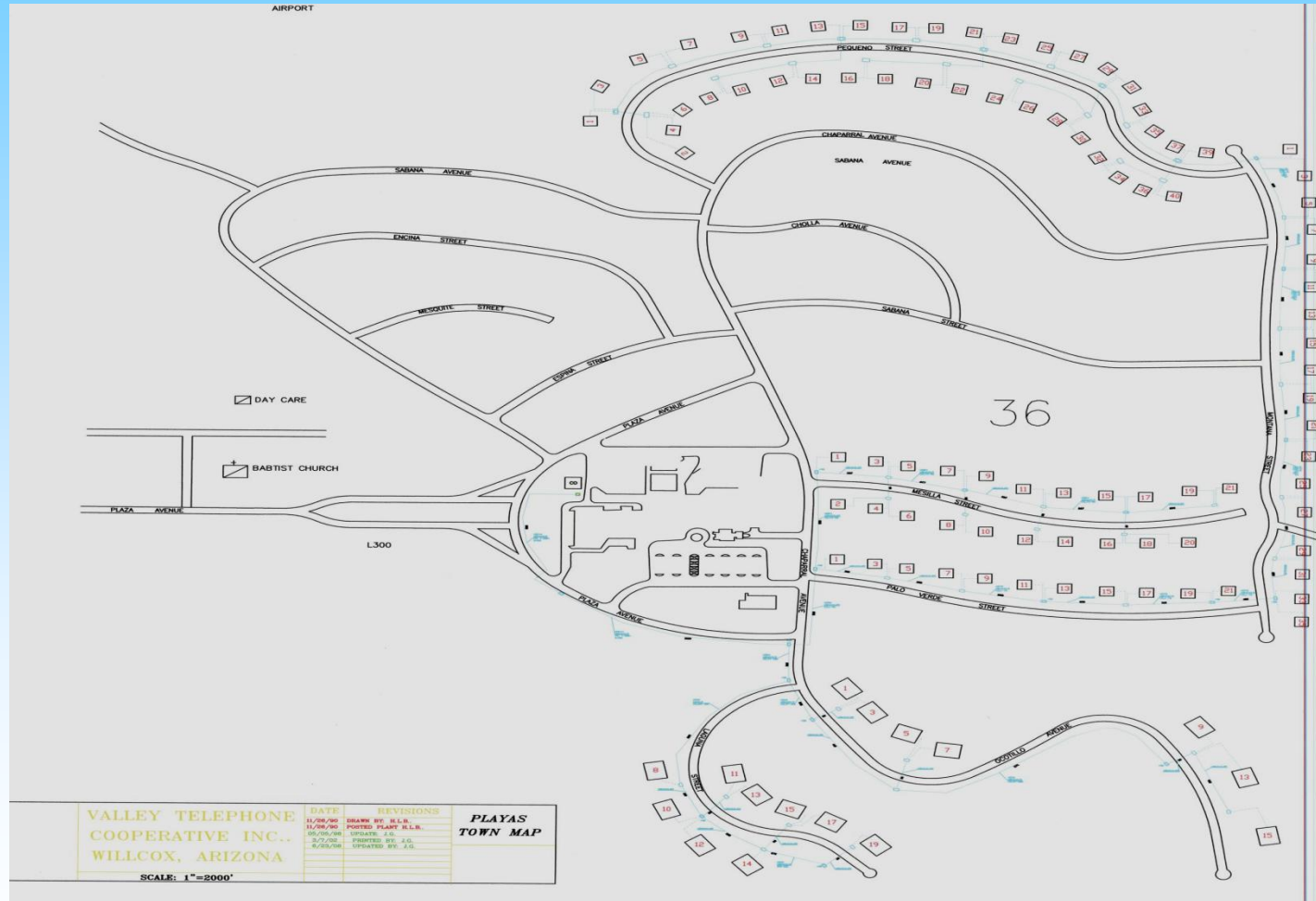
Playas Feeder at Sub Station



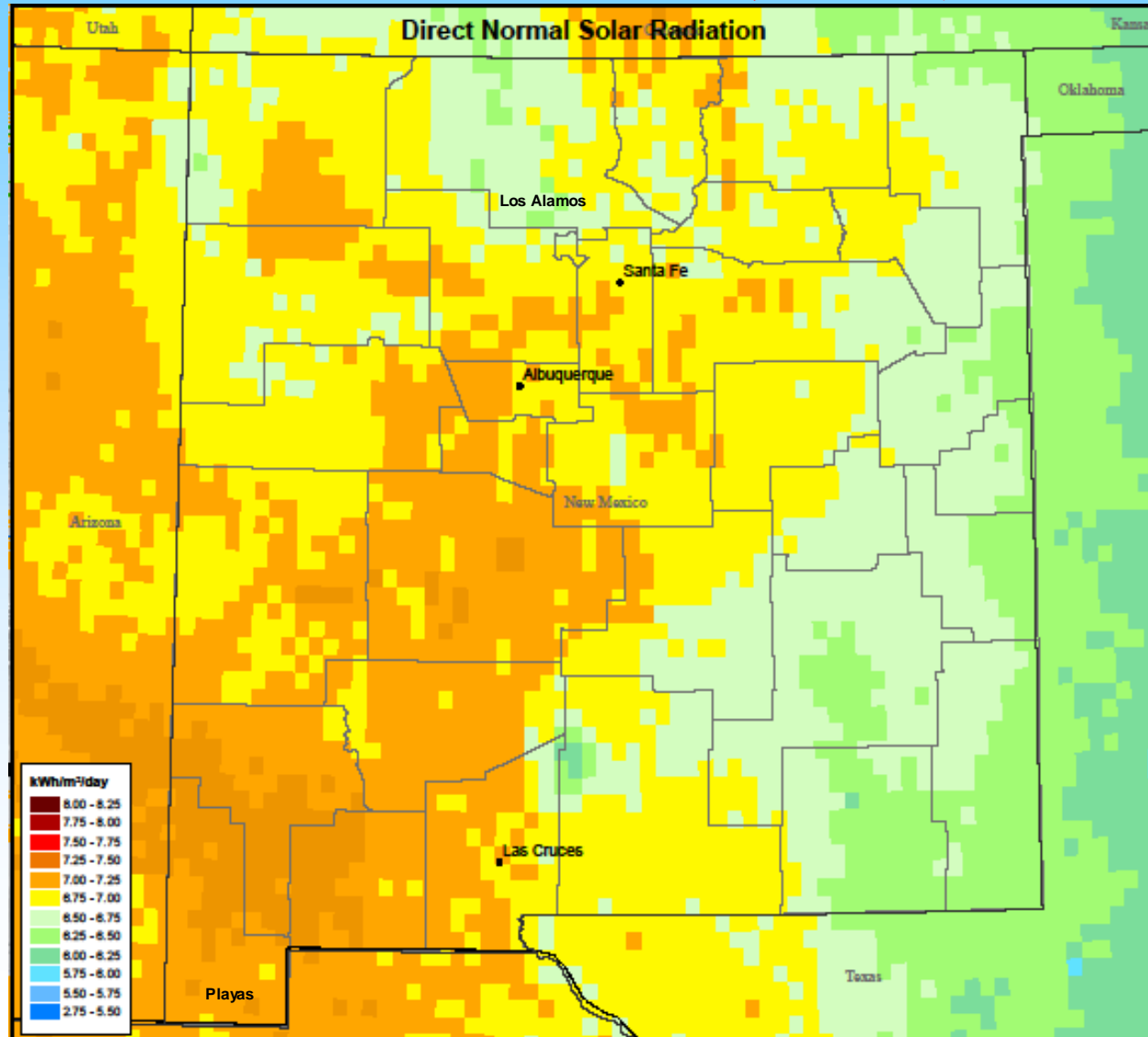
Old Analog Ink on Paper recorders
Will be updated with SCADA and
Remote 2 way communications

Measuring Power Draw from Playas at Feeder Connections

Fiber Optic Diagram of Playas



Playas has High Direct Normal Irradiation (DNI)



Playas 7.00-7.25

Albuquerque 6.75-7.00

Los Alamos 6.50-6.75

kWh/m²/day

Sub Meters installed at the 3 largest power consuming buildings



Ethernet or RS485 Communications

2 Intelligent Home Energy Systems



- 2.2kW of PV Modules
- 4kW Smart Inverter
- 16 kWhrs Battery backup
- WEB Monitor and Controls
- Automatic and manual transfer switches

12 PV Modules with active trackers

12@ 190 Watts Each= 2.2KW

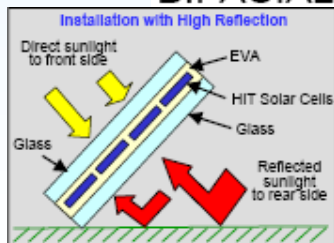


12@ 190 Watts Each= 2.2KW



SANYO HIT® Double
BIFACIAL PHOTOVOLTAIC MODULES

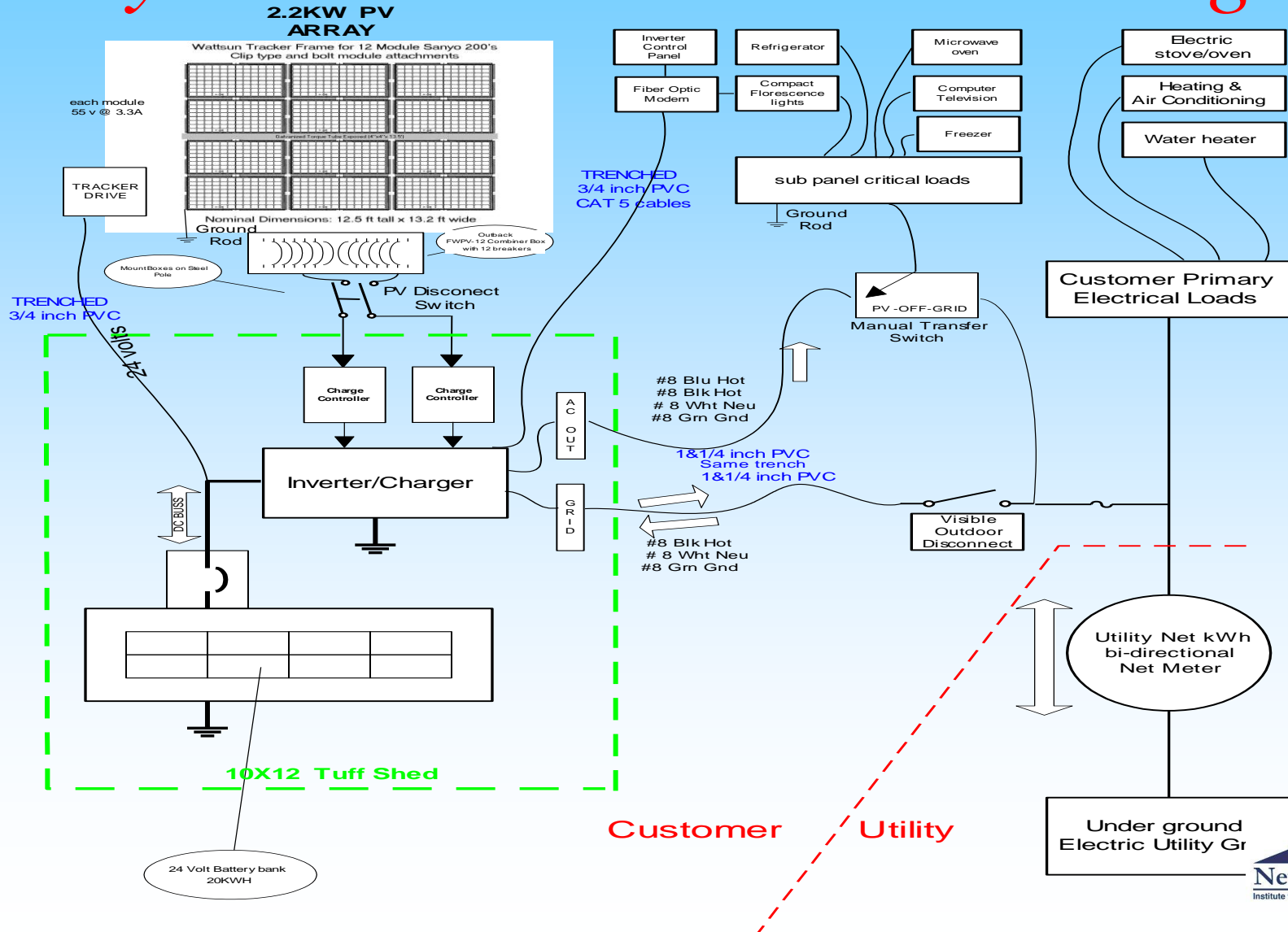
SANYO HIT PHOTOVOLTAIC MODULES



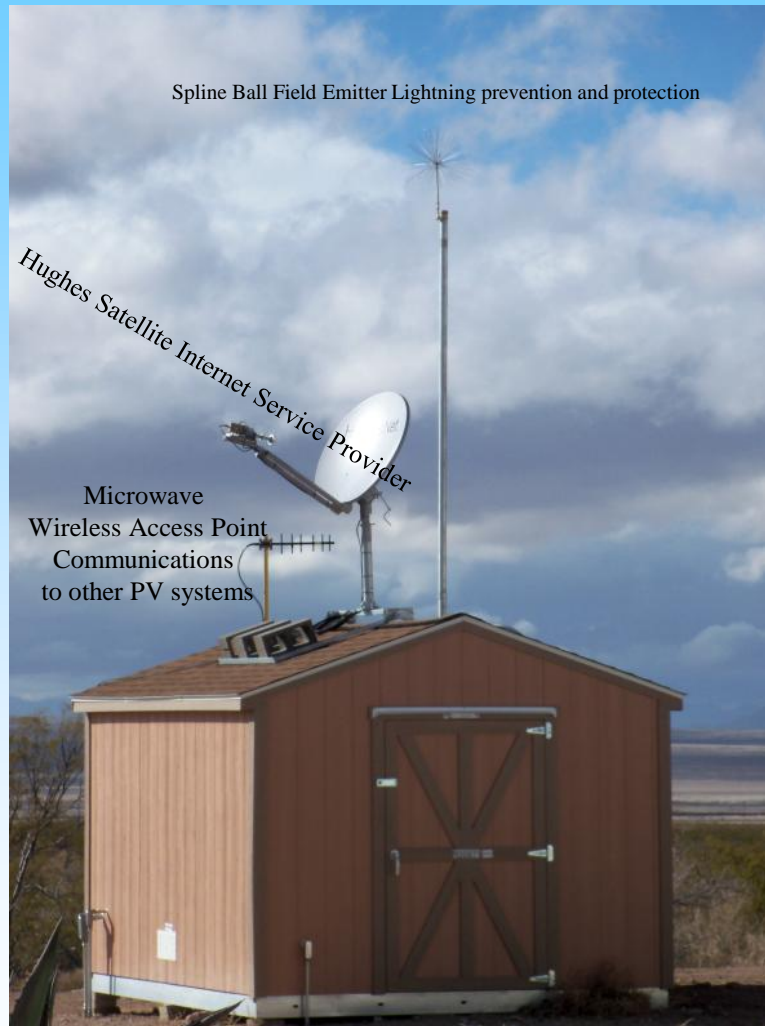
Cell Efficiency: 17.8% - 20.2%

Module Efficiency: 15.3% - 17.4%

Residential battery backed PV system 4KW & 20KWH storage



Residence # 10 Laguna



Residence # 10 Laguna

xantrex
XW Series



Xantrex XW Hybrid Inverter/Charger

The NEXT generation inverter/charger for renewable energy systems and backup power applications

True sine wave inverter
95% efficient

Maximum Power Point
Controller **MPPT**



Remote Control

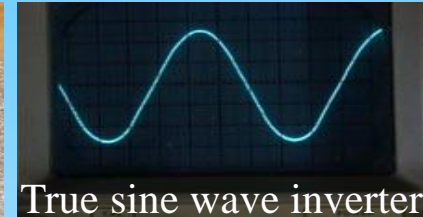


Sunette

10 Year life
6Volts 350AH each
2 sets of 4 in series

Residence on # 12 Laguna

OutBack
Power Systems



True sine wave inverter

92% efficient
Maximum Power Point
Controller **MPPT**
Built in Web Server
And weather station.

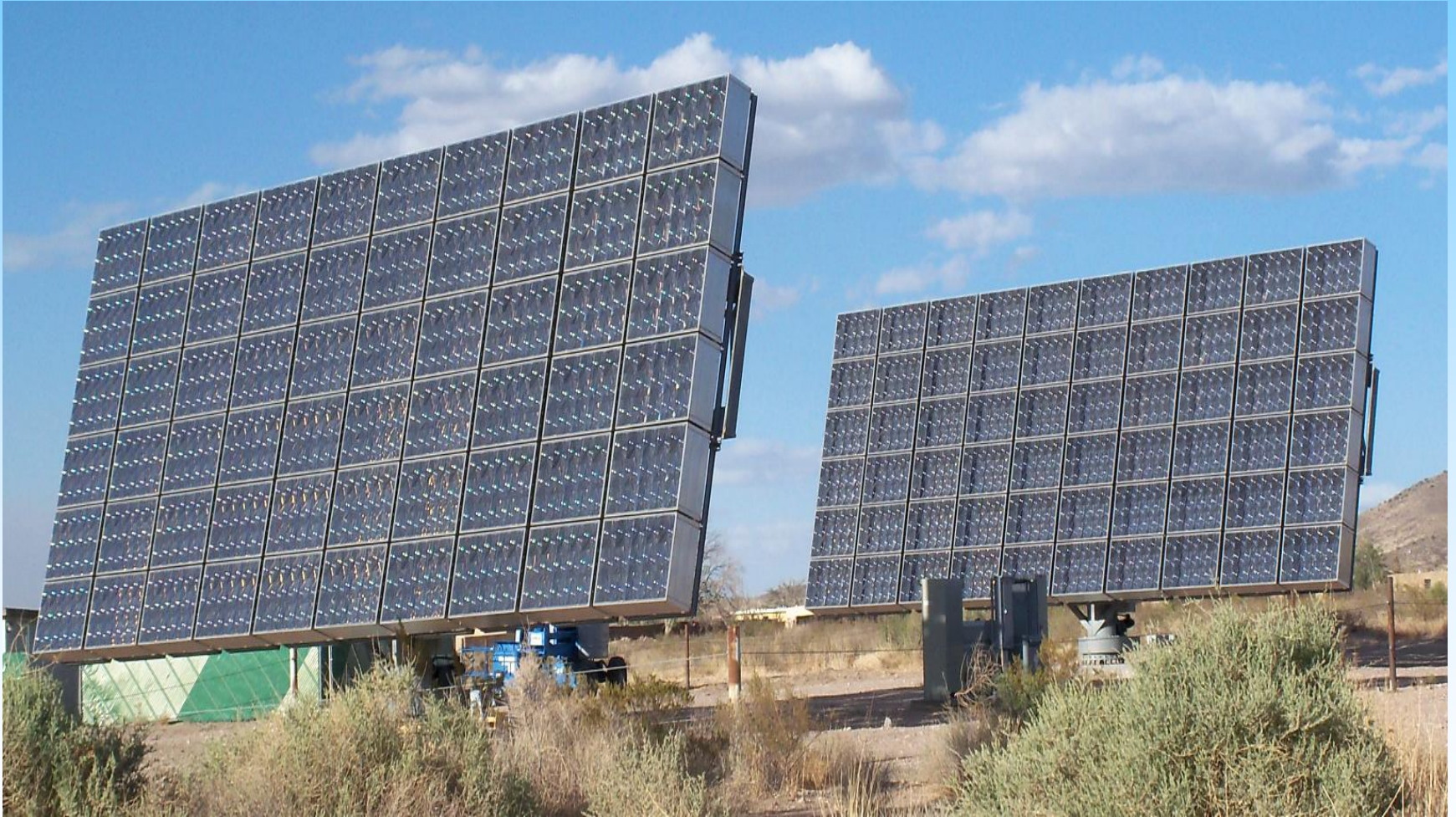


Remote Control



5 Year life
6Volts 370AH each
2 sets of 4 in series

Bulk Energy Production 2 Each 25KW CPV Sun Tracking Arrays



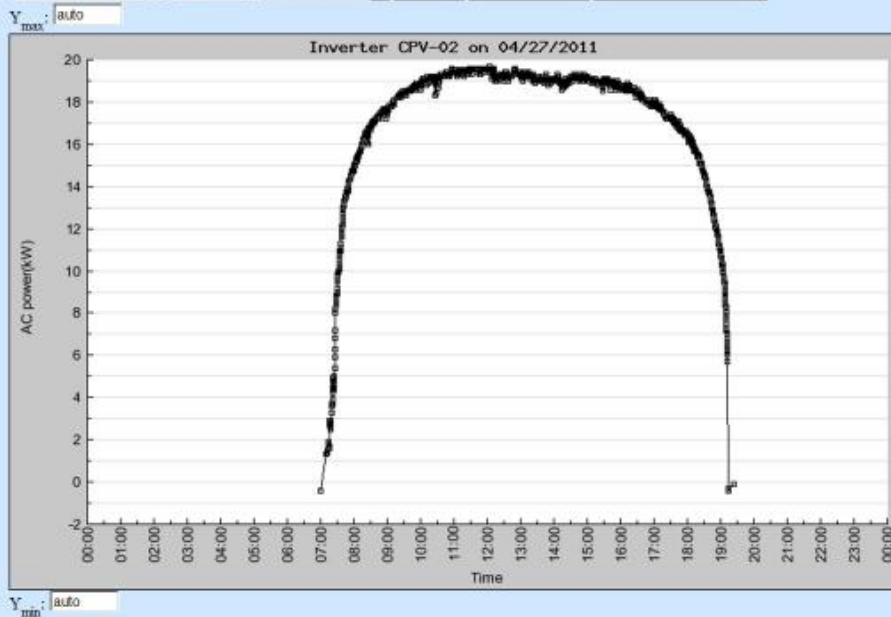
PV daily performance 24 Hrs

Today is: Apr 28, 2011
Local time: 16:36:51

Sun azimuth: 261.62 °
Sun elevation: 40.17 °

CPV-02 inverter performance at Apr 27, 2011

mon/day/year
AC power single day 04/27/2011 Refresh Export data Back to main page

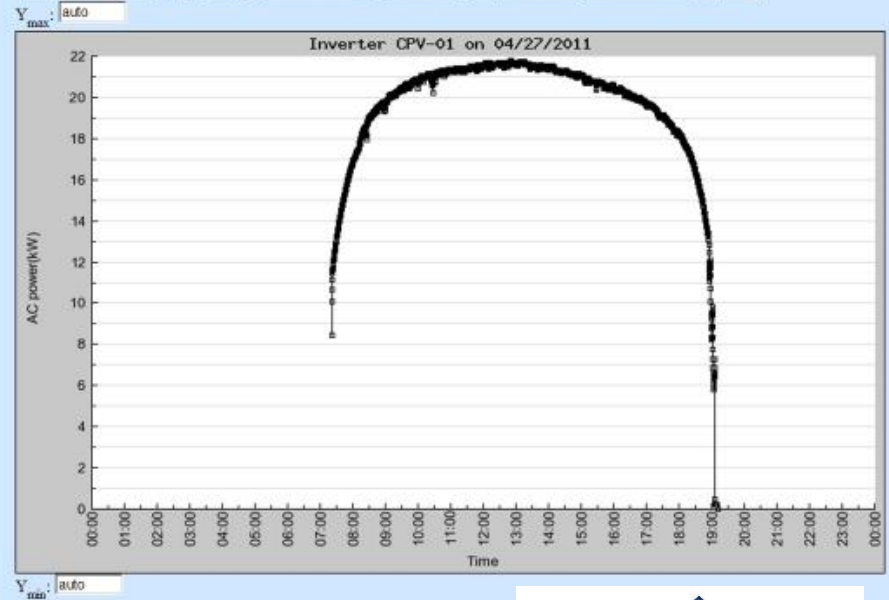


Today is: Apr 28, 2011
Local time: 16:49:10

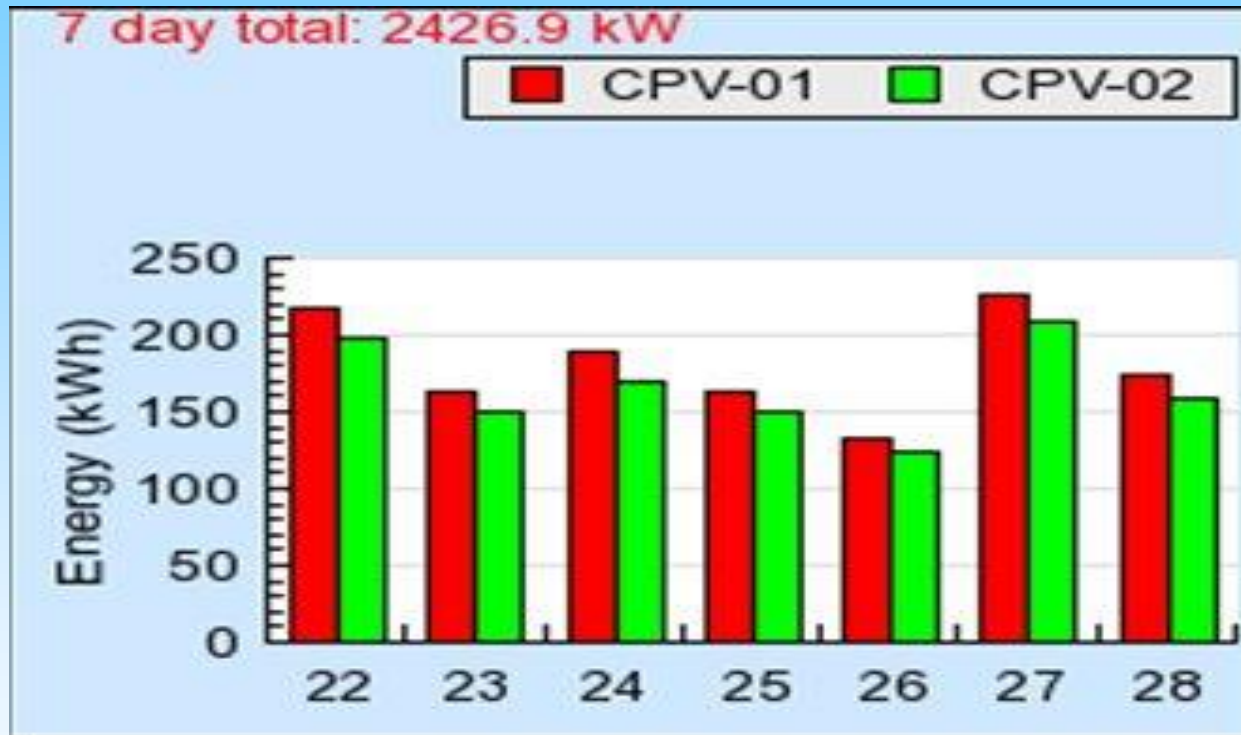
Sun azimuth: 263.51 °
Sun elevation: 37.59 °

CPV-01 inverter performance at Apr 27, 2011

mon/day/year
AC power single day 04/27/2011 Refresh Export data Back to main page



PV Weekly performance 2.4mW



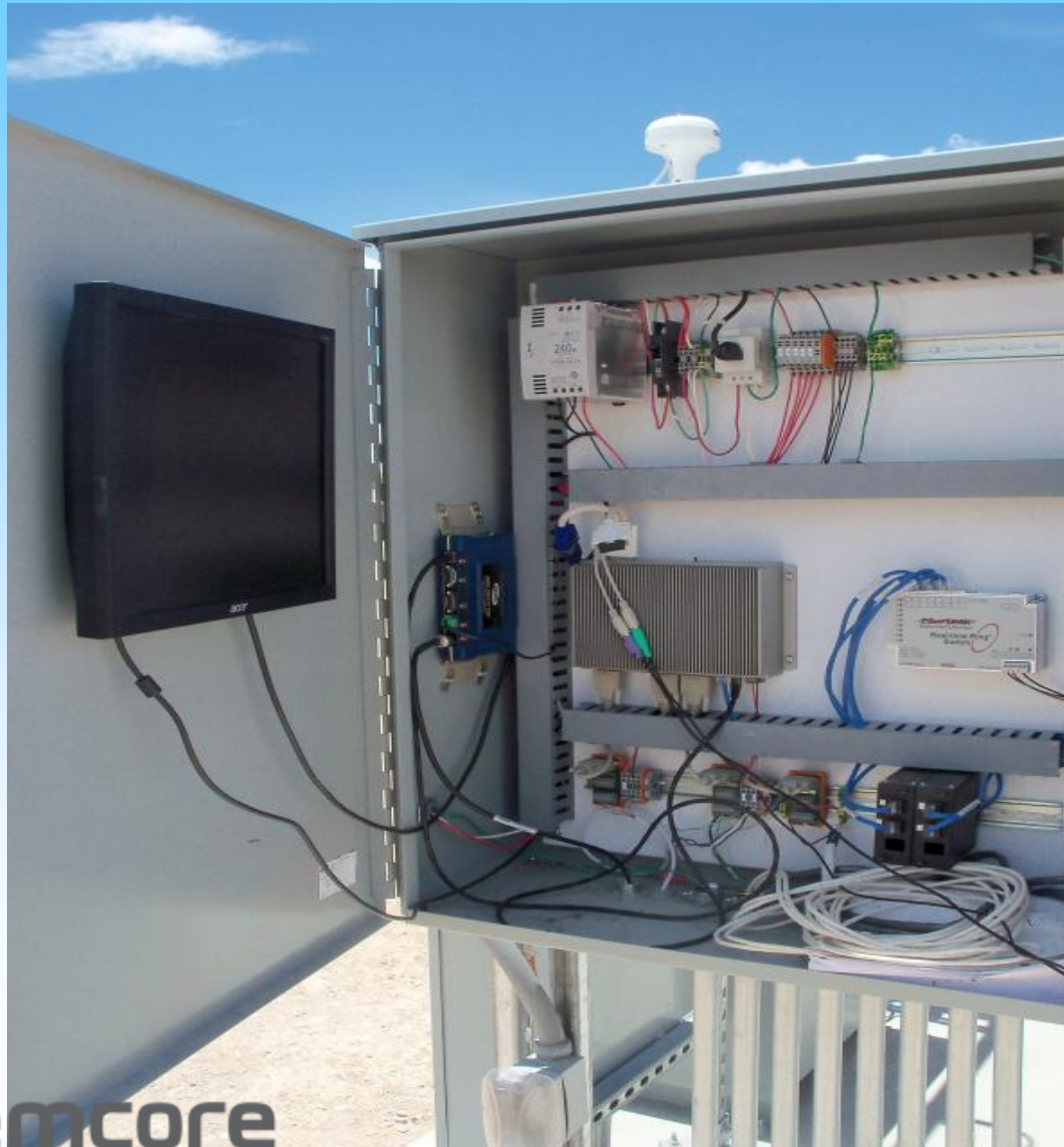
Inverter Testing



Connection to Grid 50kW



SCADA controls



The need for Clean Power



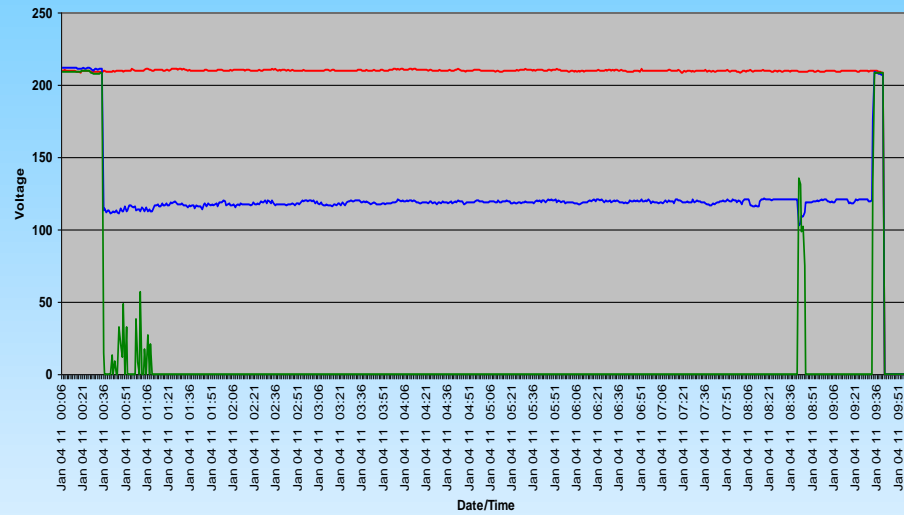
Analyst Room



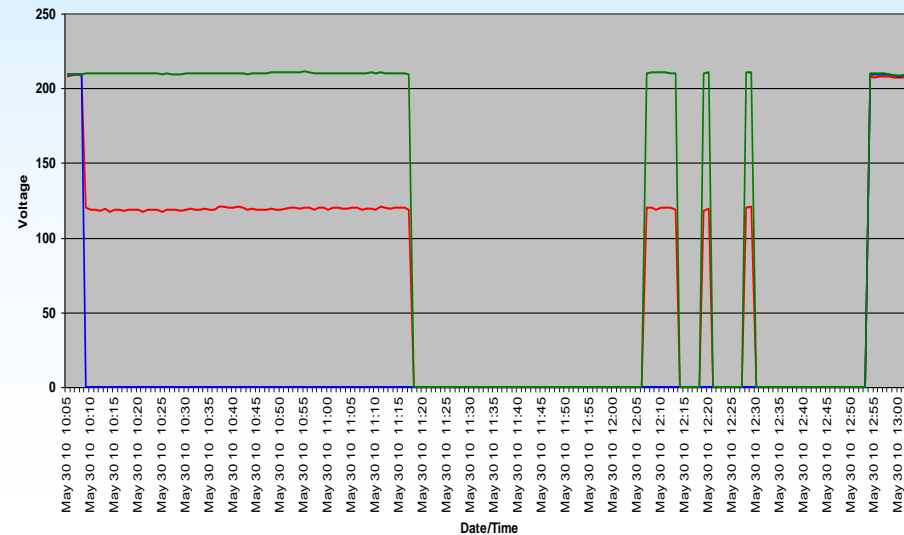
Command Room

3 Phase utility outages destroys sensitive Equipment

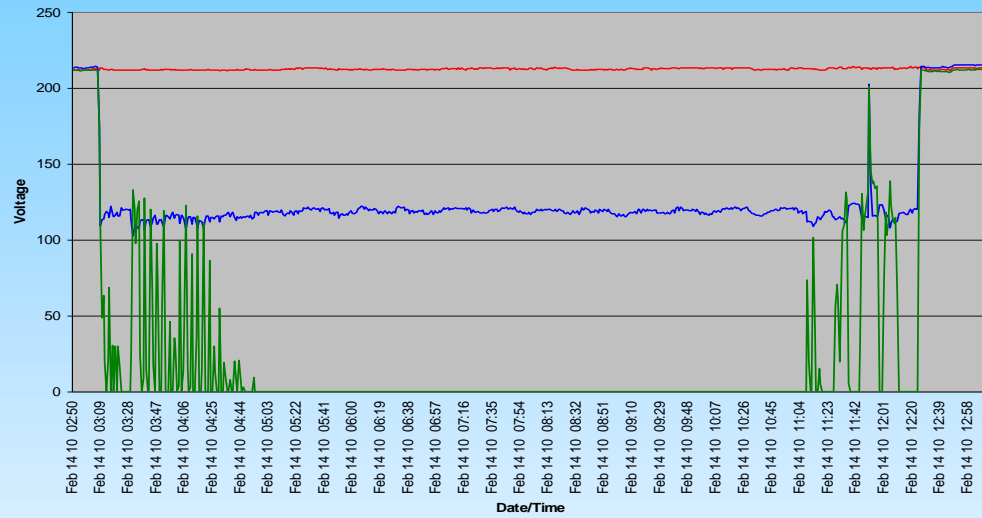
Payas Power Outage January 2011 (10hrs)



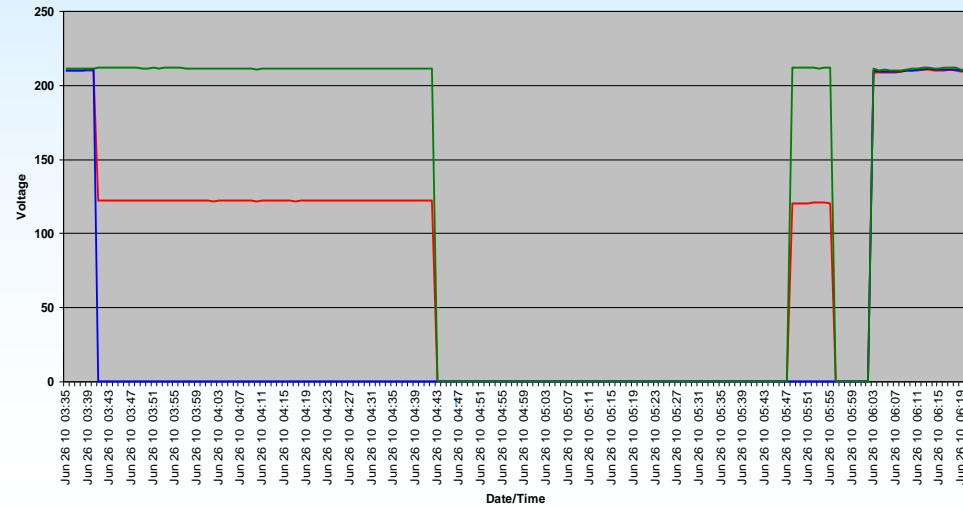
Payas Power Outage May 2010 (3hrs)



Payas Power Outage February 2010 (10hrs)



Payas Power Outage June 2010 (3hrs)



Classroom Critical Power system

- System components are programmable interactive, grid connected with sell back capability and SCADA controls
- 18kW of 3 phase Clean uninterruptible power
- 36kW of surge capacity
- Subpanel feeds critical IT infrastructures and lighting
- 12.5kW of Solar PV Modules
- 72 kWhr of Absorbed Glass Matt batteries
- Uninterruptible Information Technology (IT) platform



Playas Classroom 18 kW Critical Power system

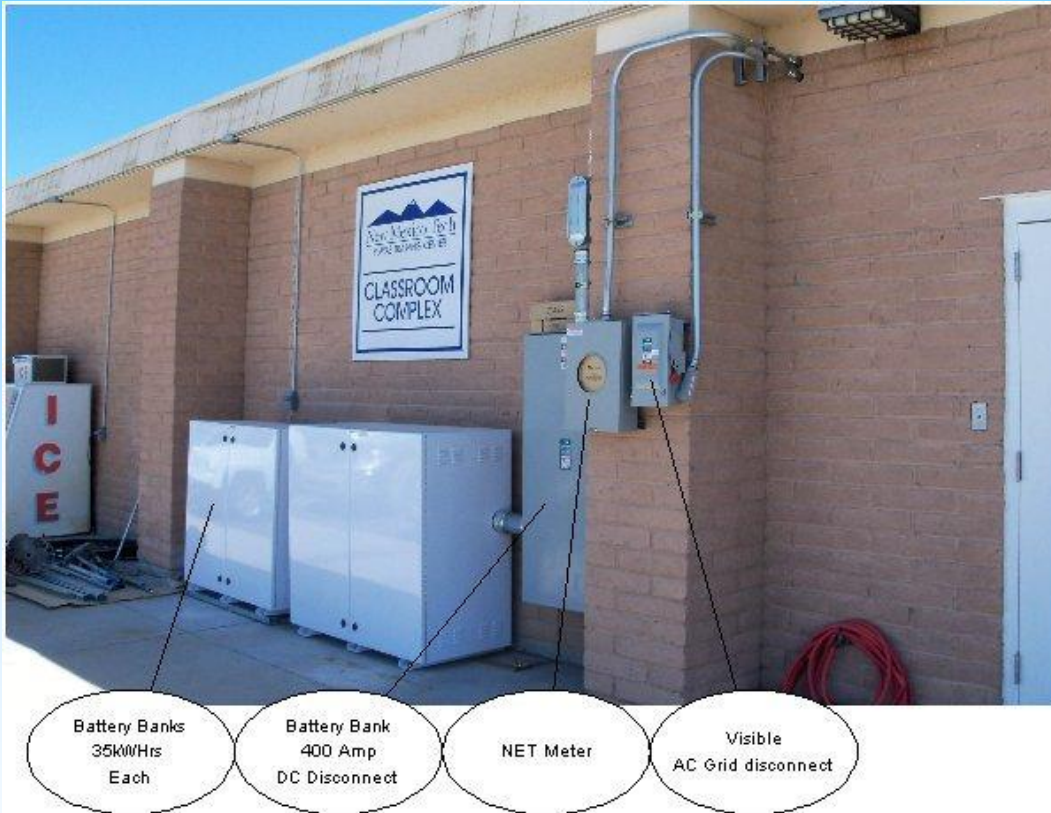


Parking shade
With 120V outlets

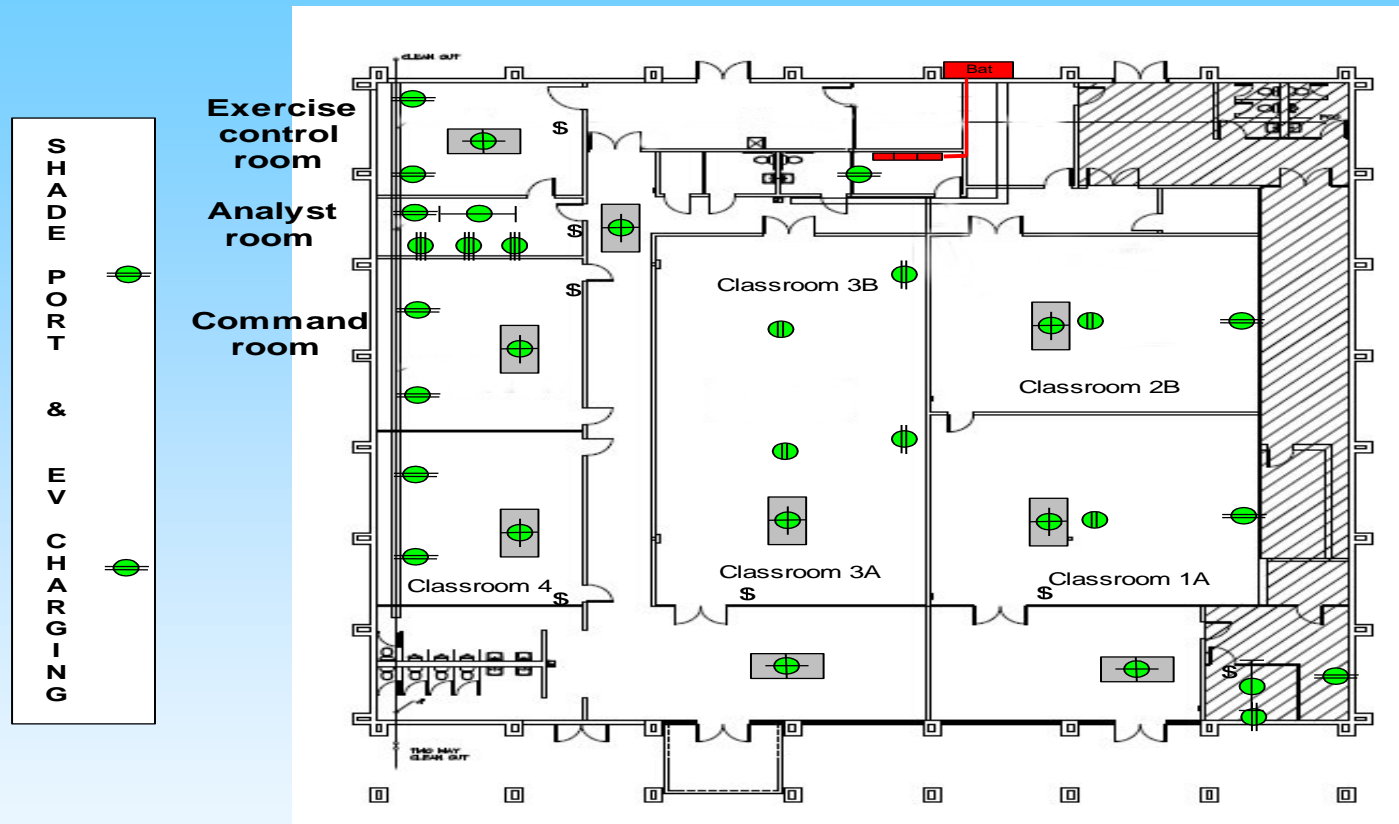










Inverter Room
With SCADA

AGM Battery backup 72kWHrs



Classroom Critical loads



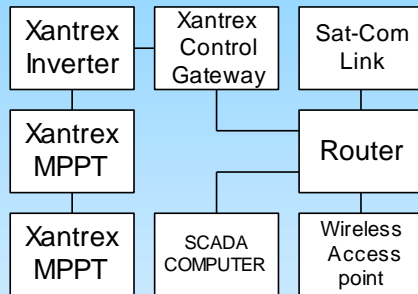
-  Ceiling mount 120V outlets
-  Wall mount 120V outlets
-  Wall mount 208V 20A outlet
-  Existing 2 lamp 2X4 fixture to be on PV sys W/retrofit
-  Existing fixture to be on PV sys W/switch
-  Wall mounted switch
-  Battery & DC Buss
-  Inverter/Chargers

Information Technology Command & Control Infrastructure

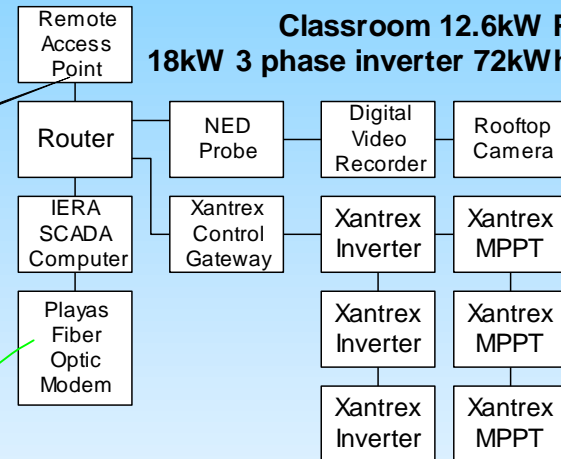


Hughes Satellite Internet Service Provider

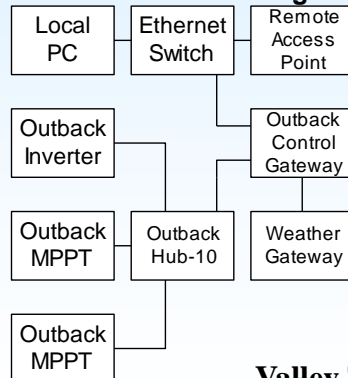
**Residence 10 Laguna 2.2kW PV
4kW Inverter 25kWhrs Storage**



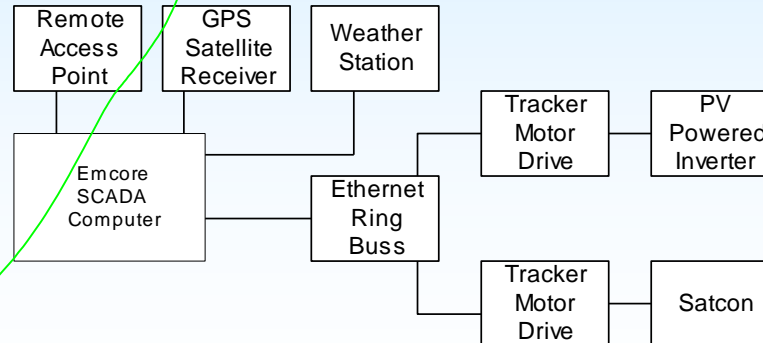
**Classroom 12.6kW PV
18kW 3 phase inverter 72kWhrs Storage**



**Residence 12 Laguna 2.2kW PV
3.6kW Inverter 16kWhrs storage**



Emcore 50kW PV 3 phase grid tie



Valley Telephone underground fiber optic network



Shade-Carport with Electric Vehicle Charging and LED lighting

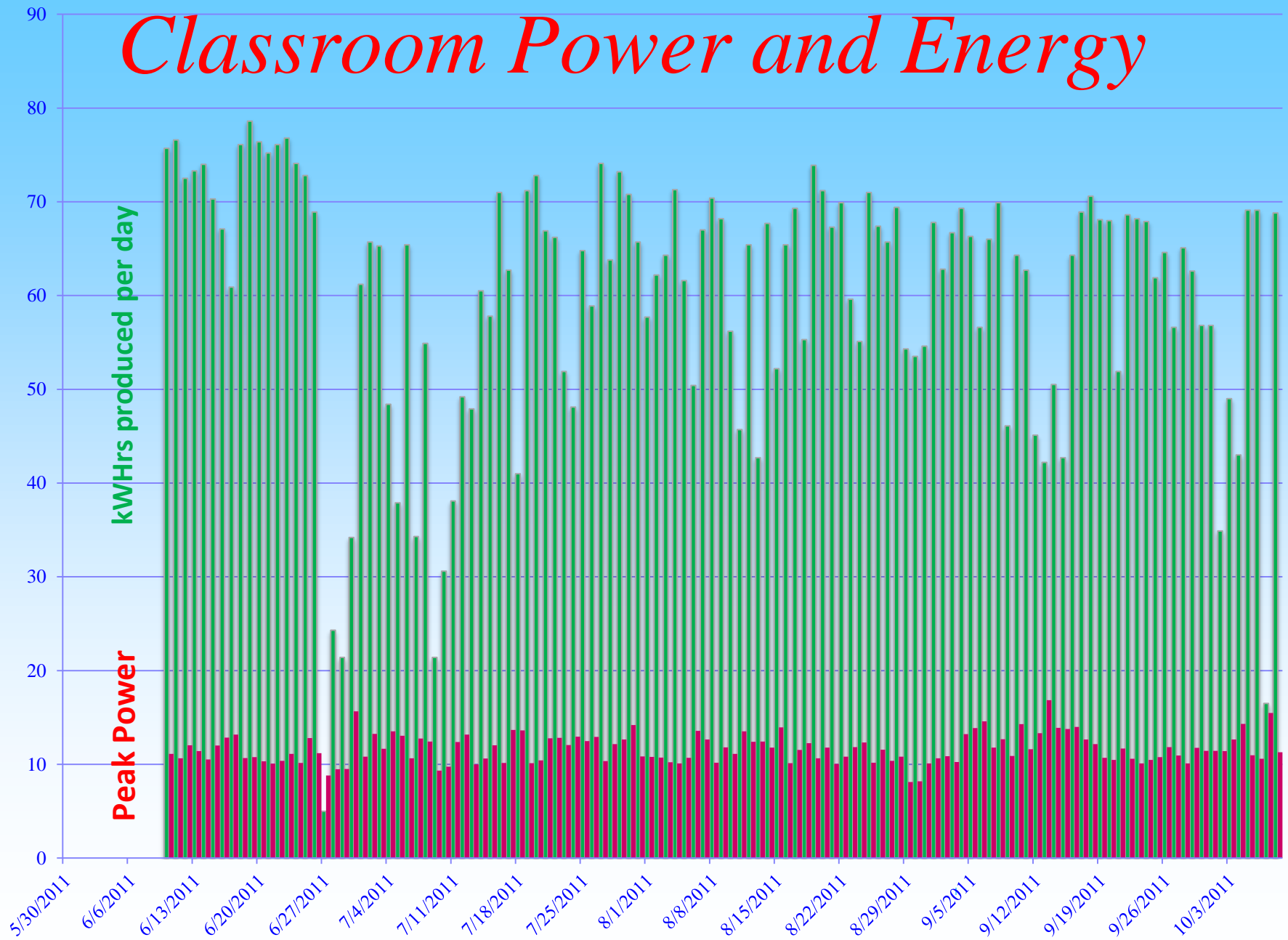


18kW 3-Phase Inverter with Intelligent controls



72kWHrs of Battery Backup

Classroom Power and Energy

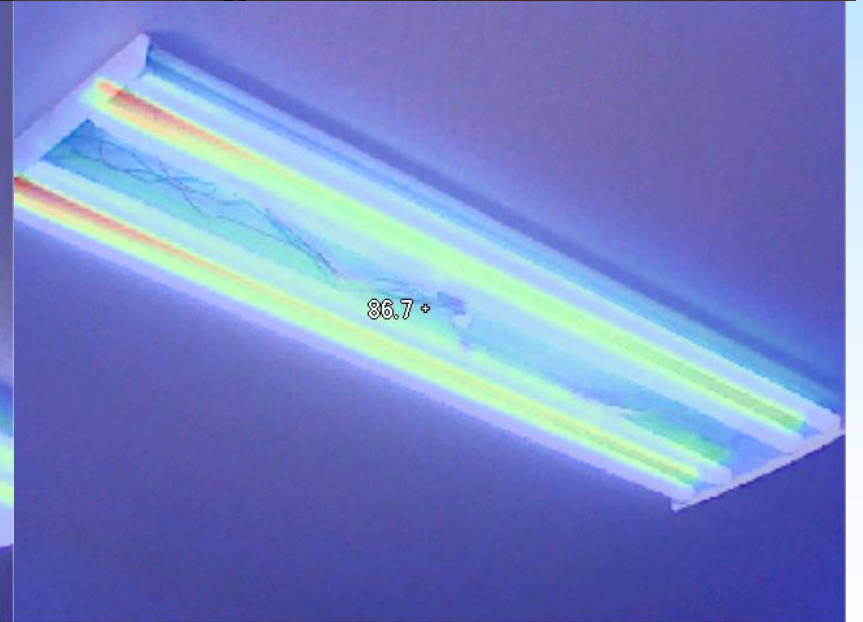
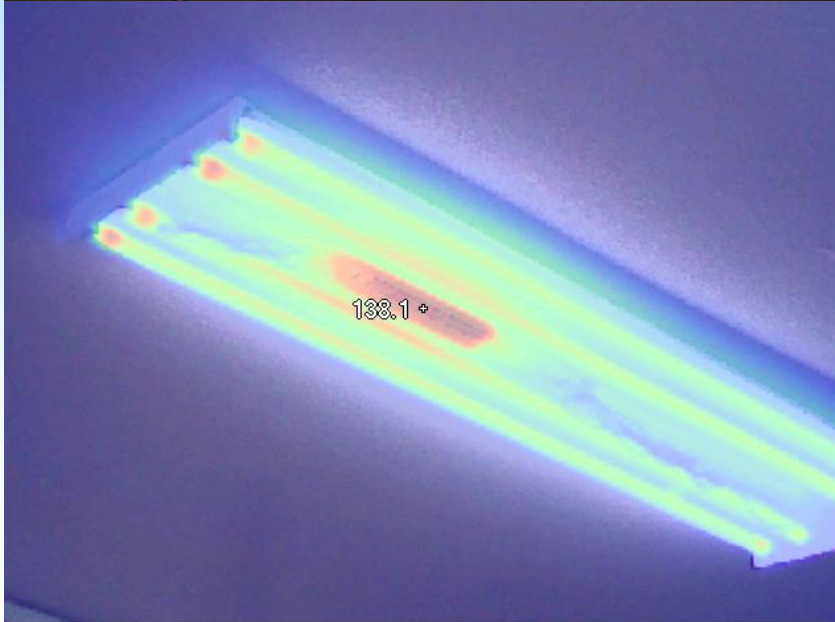


Energy Use Reduction



LEDs 50% Less Energy 25% more light

4 Foot Fluorescent/Ballast VS LED



160 Watts 70.6 Foot Candles

72 Watts 79.6Foot Candles

Incandescent VS LED

44 Lamps replaced 11,000 Watts VS 660 watts = 94% savings



250Watt Tungsten Halogen



15Watt LED

25X Longer 16.6X Less Energy

Lighting Upgrade at Community Center



8 Foot Fluorescent/Ballast VS LED



120 Watts 35.9 Foot Candles



60 Watts 58.2 Foot Candles

Conclusions

- Lessons learned from working with a local co-op
- 4 PV systems installed (add on capable)
- Potential renewable energy credits
- NMT owned systems that can be used for research and data collection
- Data availability
- Demonstrated energy savings in lighting and heat loads
- Secure reliable systems possible through use of renewables